Solar Electricity

When sunlight strikes certain materials—such as silicon—electrons are set in motion. These moving electrons can be drawn off as electricity. That is the basic principle of photovoltaic conversion, or PV, the method of providing power to nearly all the satellites launched into space. In recent years, PV has been getting more of a foothold in practical Earth applications.

The first step in producing a PV system is to make the solar cells, very thin, treated wafers of extremely pure silicon sliced from cylindrical crystals "grown" from molten silicon. Then the cells are electrically connected and encased in weatherproof packages called modules. Several modules join together to form a panel and any number of panels can be assembled to form a PV array.

NASA pioneered PV power for spacecraft and has been very active in support of Department of Energy (DoE) programs designed to expand Earth applications. Lewis Research Center supports DoE by conducting demonstrations of the advantages of this type of power generation. NASA's Jet Propulsion Laboratory (JPL) is the organization primarily responsible for developing advanced PV technology and finding ways to cut costs. Research has gradually reduced the cost to the point where PV is in practical use in a number of Third World areas where no established energy network exists. In developed countries, it is still too expensive for widespread commercial, industrial and residential applications but it is making an appearance as a working component of the U.S. utility grid.

"People have traditionally thought of photovoltaics as a technology with promise of becoming a source of utility scale energy in the more or less distant future," says James H. Caldwell, president of ARCO Solar, Inc., Camarillo, California, a subsidiary of Atlantic Richfield Company. "The fact is, photovoltaics is already a business, using today's technology to supply power *today*."

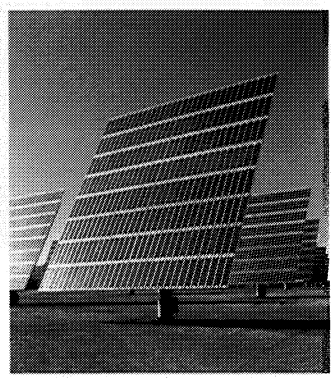
ARCO Solar manufactures PV systems tailored to a broad variety of applications. PV arrays are routinely used at remote communications installations to operate large microwave repeaters, TV and radio repeaters, rural telephones and small telemetry systems that monitor environmental conditions. They are also used to power agricultural water pumping systems, to provide electricity for isolated villages and medical clinics, for corrosion protection for pipelines and bridges, to power railroads signals and air/sea navigational aids, and for many types of military systems. Since 1982, ARCO has been moving into large scale PV power generation for utilities. A JPL contractor since the early development of Earth-use solar arrays, ARCO Solar designed and built some of the world's largest PV systems.

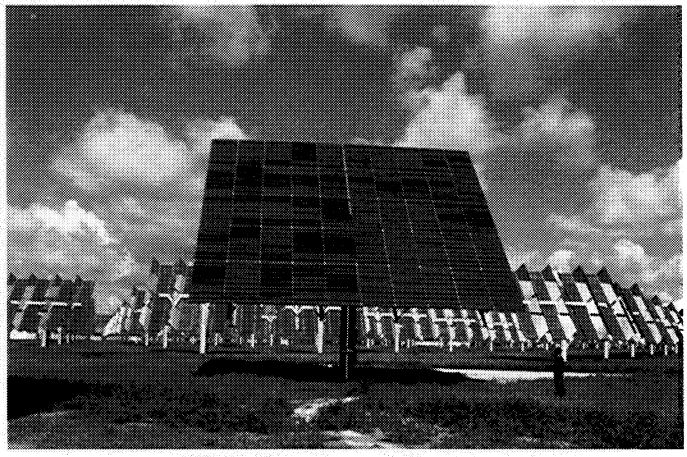
Shown above is an ARCO Solar PV power plant located on 20 acres at Hesperia, California. It is capable of generating one megawatt of electrical power and supplying 3 million kilowatt hours of electricity annually; at the time of the plant's dedication in 1983, its rated capacity was three times greater than any PV system in the world. The system makes maximum use of available sunlight by means of automatic, computer-controlled

trackers that continually point the PV panels directly at the Sun for efficient acquisition of solar radiation.

The Hesperia station has 256 PV modules on each of 108 tracker pedestals. Its electricity, enough to serve 300-400 homes, is purchased by Southern California Edison Company (SCE) and fed to SCE's utility grid. Between the plant and the utility grid is an inverter station that converts the electricity from direct current (DC), the type of current generated by PV systems, to alternating current (AC), the current to which the U.S. utility grid is geared.

ARCO Solar also built a one megawatt facility for the





Sacramento (California) Municipal Utility District. But the granddaddy of all PV systems is ARCO Solar's 6.5 megawatt plant at Carrisa Plains, just west of Bakersfield in California's Kern County. The 160-acre plant, part of which is shown above, has 756 solar trackers, each with 16 PV panels. It produces almost 14 million kilowatt hours a year, enough to serve 2,300 average homes, and feeds it to the grid of Pacific Electric Company. It is planned to boost the Carrisa Plains capacity eventually to 16 megawatts.

ARCO Solar has PV installations on five continents and the company's broad product line ranges from mammoth systems like Carrizo Plain to simple units that provide power for recharging recreational vehicles batteries. An in between example is pictured at left; it is a three-acre, 300 kilowatt municipal utility financed by the city of Austin, Texas. ARCO Solar won the bid for the plant, provided the design and the PV modules. ▲